

CLAIMS

1. A method of reducing impact of transmission errors by means of a retransmission protocol, the method characterized in that a retransmission loop involving packet radio transmissions from user equipment to a control element connected to one or more radio base stations, the user equipment radio transmissions being received at one or more radio base stations for forwarding to the control element, the base station acknowledging, positively or negatively, transmissions from the user equipment and the control element acknowledging, positively or negatively, transmissions forwarded to it.
2. The method according to claim 1 characterized in that for a process of retransmission, if same transmitted packet information content is received more than once, the received transmissions are combined.
3. The method according to claim 2 characterized in that successive received packet transmissions of the same information content are combined in the base station prior to determining whether or not the radio base station should acknowledge the transmitted information content.
4. The method according to claim 2 or 3 characterized in that whether or not the packet information content is the same is determined by means of a new data indicator.
5. The method according to claim 4 characterized in that the new data indicator, accompanying packet information, is transmitted on a reliable control channel.

6. The method according to any of claims 2-5 c h a r -
a c t e r i z e d i n that the process is identified by
means of a process identity.

7. The method according to claim 6 c h a r a c t e r -
5 i z e d i n that the process identity, accompanying
packet information, is transmitted on a reliable control
channel.

8. The method according to any of claims 1-7 c h a r -
a c t e r i z e d i n that the control element reorders
10 received packets.

9. The method according to claim 8 c h a r a c t e r -
i z e d i n that the received packets are reordered into
sequential order.

10. The method according to claim 9 c h a r a c t e r -
15 i z e d i n that the sequential order is determined from
RLC sequence number.

11. The method according to claim 9 c h a r a c t e r -
i z e d i n that the sequential order is determined from
MAC sequence number.

12. The method according to any of claims 1-11 c h a r -
20 a c t e r i z e d i n that the method reduces delay of
uplink transmissions, the delay being associated with the
retransmissions.

13. A signal format for uplink transmissions from user
25 equipment to radio base station of a radio communications
system, the signal format c h a r a c t e r i z e d b y
signal elements

- process identity,
- new data indicator, and

- payload,

the new data indicator indicating whether or not payload data of a process with identity as indicated by the process identity element has been transmitted previously.

- 5 14. The signal format according to claim 13 c h a r a c -
t e r i z e d i n that the process identity and new data
indicator elements are more strongly protected by a forward
error control code than payload.
- 10 15. The signal format according to claim 13 or 14
c h a r a c t e r i z e d i n that the process identity
and new data indicator elements are transmitted on a con-
trol channel in synchronism with transmissions of the pay-
load element.
- 15 16. The signal format according to claim 15 c h a r a c -
t e r i z e d i n that the control channel is a shared
control channel of a UMTS or WCDMA system.
17. The signal format according to claim 15 c h a r a c -
t e r i z e d i n that the control channel is a dedicated
control channel of a UMTS or WCDMA system.
- 20 18. The signal format according to any of claims 13-17
c h a r a c t e r i z e d b y the payload element com-
prising an integer number of radio link control protocol
data units (RLC PDUs).
- 25 19. The signal format according to any of claims 13-18
c h a r a c t e r i z e d i n that the process identity,
new data indicator and payload elements are arranged for
uplink transmission in a transmission time interval shorter
than 10 milliseconds.

20. The signal format according to claim 19 c h a r a c -
t e r i z e d i n that the process identity, new data in-
dicator and payload elements are arranged for uplink trans-
mission in a transmission time interval shorter than 4 mil-
5 liseconds, e.g. 2 ms.

21. A radio network controller of a radio communications
system c h a r a c t e r i z e d b y

- receive means, for receiving first protocol
data units,
- 10 - buffering means, for buffering received first
protocol data units,
- segmentation means, for segmenting received
first protocol data units into second protocol
data units
- 15 - reassemble means, for reassembling second pro-
tocol data units into service data units.
- transfer means, for transferring service data
units.

22. The radio network controller according to claim 21
20 c h a r a c t e r i z e d b y

- reordering means, for reordering second proto-
col data units,

23. The radio network controller according to claim 21
c h a r a c t e r i z e d b y

- 25 - reordering means, for reordering first protocol
data units,

24. The radio network controller according to any of
claims 21-23 c h a r a c t e r i z e d b y

- transmit means,

the processing means being arranged to verify second protocol data units according to an error detecting code and the transmit means transmitting positive or negative acknowledgments depending on whether or not the second protocol data unit is detected to be erroneous.

25. The radio network controller according to claim 21 or 24 characterized in that the reordering means rearranges the second protocol data units according to an RLC sequence number.

26. The radio network controller according to any of claims 21-25 characterized by receive means arranged for receiving first protocol data units concerning a particular connection from a plurality of first protocol data senders.

27. The radio network controller according to any of claims 21-26 characterized in that the first protocol data units are MAC PDUs.

28. The radio network controller according to any of claims 21-27 characterized in that the second protocol data units are RLC PDUs.

29. The radio network controller according to any of claims 21-28 characterized in that the radio network controller is a radio network controller of a UMTS or WCDMA system.

30. A radio base station characterized by

- receive means, for receiving one or more first protocol data units,

- a protocol entity, for processing first protocol data units, and
- transmit means, for transmitting acknowledgments and for forwarding of first protocol data units.

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31. The radio base station according to claim 30 characterized by

- buffering means, for buffering one or more first protocol data units.

10 32. The radio base station according to claim 30 or 31 characterized by the protocol entity being arranged for verifying one or more first protocol data units according to a forward error control code, and depending on the outcome positively or negatively acknowledging to an uplink transmitting entity received first one or
15 more protocol data units.

33. The radio base station according to any of claims 30-32 characterized by means for combining received first protocol data units, the protocol entity being
20 arranged to verify the combined protocol data unit according to a forward error control code and depending on the outcome positively or negatively acknowledging to an uplink transmitting entity the latest received protocol data unit of the combination.

25 34. The radio base station according to claim 33 characterized in that the first protocol data units with same process identity are combined according to a received new data indicator.

35. The radio base station according to any of claims 30-34 characterized in that the first protocol data units are MAC PDUs.

5 36. The radio base station according to any of claims 30-35 characterized in that the radio base station is a radio base station of a UMTS or WCDMA system.

37. A user equipment apparatus of a radio communications system characterized by

- 10 - assemble means for assembling one or more second protocol data units into one or more first protocol data units,
- buffering means for buffering first protocol data units,
- 15 - transmit means for transmitting first protocol data units,
- receive means for receiving one or more acknowledgments of first protocol data units, and
- receive means for receiving one or more acknowledgments of second protocol data units.

20 38. The user equipment apparatus characterized by the transmit means being arranged to retransmit one or more first protocol data units if negatively acknowledged or not positively acknowledged within a predetermined time.

25 39. The user equipment apparatus according to claim 37 or 38 characterized by buffering means being arranged to release buffer space of one or more first protocol data units if positively acknowledged or not negatively acknowledged within a predetermined time.

40. The user equipment apparatus according to any of claims 37-39 characterized by transmit means being arranged to transmit first protocol data units in transmission time intervals shorter than 10 milliseconds.

41. The user equipment apparatus according to claim 40 characterized by transmit means being arranged to transmit first protocol data units in transmission time intervals shorter than 4 milliseconds, e.g. 2 milliseconds.

42. The user equipment according to any of claims 37-41 characterized in that the first protocol data units are MAC PDUs.

43. The user equipment according to any of claims 37-41 characterized in that the second protocol data units are RLC PDUs.

44. The user equipment apparatus according to claims 37-43 characterized in that the user equipment apparatus is user equipment of a UMTS or WCDMA system.

45. Radio communications system characterized by means for carrying out the method in any of claims 1-12.

46. A radio communications system characterized by a plurality of radio network controllers according to any of claims 21-29.

47. A radio communications system characterized by a plurality of radio base stations according to any of claims 30-36.

48. A radio communications system characterized by a plurality of user equipment apparatuses according to any of claims 37-44.